Probabilistic perspectives: How uncertainty about common ground affects domains of reference

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Perspective information distinguishes knowledge that is shared by both interlocutors (common ground) from knowledge that is privileged to one interlocutor. Psycholinguistic work has addressed the question of whether listeners take perspective by examining which referential domain listeners use when resolving a definite reference: some claimed that listeners use all objects available to them (perspective *e*), concluding they are egocentric (*e.g.* [1]), while others claimed that listeners use common ground objects as the referential domain (perspective *c*) (*e.g.* [2]). To reconcile these apparently-contradicting results, we propose a Bayesian model where listeners probabilistically integrate multiple sources of information, capturing the fact that listeners are inherently uncertain about speakers' knowledge, and gather perspective information from indirect cues.

We consider two separate probabilistic components: the ground status of objects and the fit of the RE to each object. Given the RE *the big X* (for Figure 1a) and the listener's perspective *k*, we seek the most likely referent *obj*. Using Bayes' rule:

$$P(obj\,|RE, k) \propto P(RE\,|obj, k)P(obj\,|k)$$

The first, $P(RE\,|obj, k)$, corresponds to the fit of the RE to the object—what RE is expected for each object in the domain (which depends on the properties of the object and the nature of other objects in the domain). The second probability, $P(obj\,|k)$, corresponds to the prior likelihood that the speaker will refer to the object—we assume that the speaker is less likely to refer to privileged objects, as speakers in [1,2] did not refer to objects privileged to the listener.

We expect that the listener harbours some uncertainty about the speaker's knowledge state–*e.g.*, if an object is privileged to the listener, should it be in the referential domain? To reflect this uncertainty, the model weighs the influence of two possible perspectives, egocentric (*k* = perspective *e*) and common ground (*k* = perspective *c*):

$$P(obj\,|RE) = \alpha P(obj\,|RE, k = e) + (1 - \alpha)P(obj\,|RE, k = c)$$

The parameter α expresses the listener's uncertainty about ground cues. When α is near 1, the listener weighs perspective *e* more and is thus predicted to exhibit egocentric behaviour; when α is near 0, she weighs perspective *c* more and will show perspective-taking behaviour.

We estimate the component probabilities using production data. Twelve participants instructed a confederate to click on images (interlocutors looked at different screens). We collected referring expressions in four conditions, mimicking the four perspectives in Figure 1. Figure 2 shows the model's response to those displays (there was no one-to-one correlation between absolute size and relative size in the experiment). In 2a (data for 1a), when the object that best fits the RE changes between perspectives, the target is preferred to the competitor only up to a certain level of α, so egocentric behaviour may be observed, as in [1]. In 2b (data for 1b), the target is generally preferred to the competitor, as observed by [2]. By allowing a graded notion of perspective, where a listener can be somewhere between full egocentricity and full integration of common ground, we can reconcile the results of these two apparently-contradicting studies.

(a) (b)

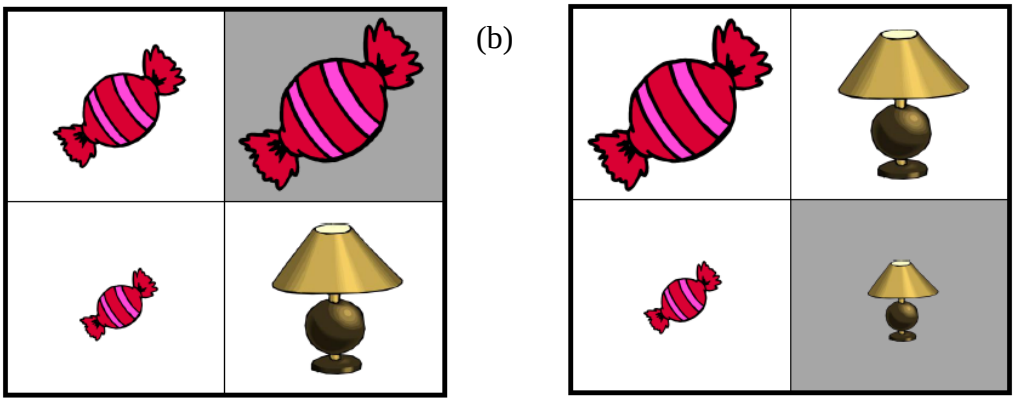

Figure 1. (a) Four-object display analogous to [1]. The object that is the best fit to the RE (the big candy) is privileged to the listener. (b) Four-object display of [2]. The target (big candy) has a shared contrast (small candy), while the competitor (big lamp) has a contrasting object privileged to the listener.

(a) (b)

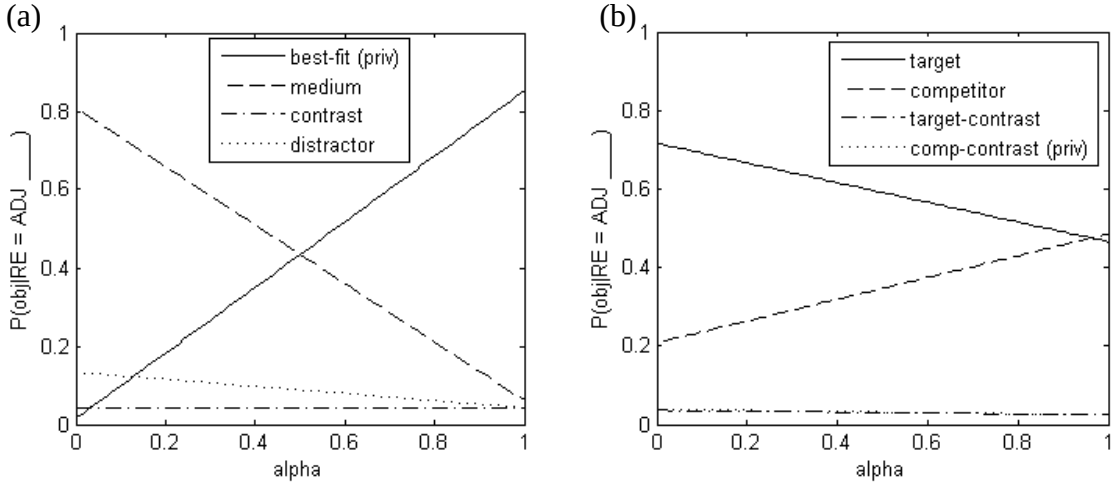

Figure 2. (a) Model simulation of [1]. Above α = 0.5, the privileged competitor is preferred over the target. The results of [1] are possible without requiring the listener to be completely egocentric (*i.e.*, α = 1). (a) Model simulation of [2]. Over virtually all values for α, the target (big candy) is preferred over the competitor (big lamp).

References:

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